

02/12/2009

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1 – 12. (Cancelled)

13. (Previously Presented) A nitriding treatment method for performing a nitriding treatment for a workpiece in a heat treatment furnace, said nitriding treatment method comprising:

a first step of applying a pulse voltage having a predetermined current density at a frequency of not less than 1 kHz between said heat treatment furnace and said workpiece to start heating said workpiece by means of generated glow discharge; and

a second step of decreasing said current density of said pulse voltage after a temperature of said workpiece arrives at 350 °C, and then heating said workpiece up to a desired nitriding treatment temperature by using a heating element arranged around said workpiece, wherein

said nitriding treatment is performed by means of nitrogen ion or nitrogen radical generated by said glow discharge.

14. (Currently Amended) The nitriding treatment method according to claim 13, wherein

said workpiece is heated by heat generated by said glow discharge and said heating element in said first step; and

heating is effected in said second step such that an amount of heat generated by said heating element is higher than that at any time in said first step.

15. (Original) The nitriding treatment method according to claim 13, wherein said current density of said pulse voltage is gradually decreased in said second step, while said workpiece is gradually heated up to said nitriding treatment temperature by using said heating element arranged around said workpiece.

16. (Original) The nitriding treatment method according to claim 13, wherein said nitriding treatment temperature is maintained to execute said nitriding treatment after said workpiece arrives at said desired nitriding treatment temperature in said second step.

17. (Original) The nitriding treatment method according to claim 13, wherein said current density of said pulse voltage is 0.05 to 7 mA/cm².

18. (Original) The nitriding treatment method according to claim 13, wherein said current density of said pulse voltage is 0.1 to 4 mA/cm².

19. (Currently Amended) The nitriding treatment method according to claim 13, wherein said temperature of said workpiece is determined by ~~simultaneously~~ detecting a temperature difference between a radiation temperature and a contact temperature of a dummy workpiece arranged in said heat treatment furnace, simultaneously detecting a radiation temperature of said workpiece, and correcting said radiation temperature of said workpiece with said temperature difference.

20. (Withdrawn) A nitriding treatment apparatus for performing a nitriding treatment for a workpiece in a heat treatment furnace, said nitriding treatment apparatus comprising:

a glow discharge-generating means which generates glow discharge by applying a pulse voltage having a predetermined current density at a frequency of not less than 1 kHz between said heat treatment furnace and said workpiece;

a heating means which heats said workpiece by using a heating element arranged in said heat treatment furnace;

a temperature-detecting means which detects a temperature of said workpiece;
and

a control means which controls said current density of said glow discharge effected by said glow discharge-generating means on the basis of said temperature of said workpiece detected by said temperature-detecting means and which controls said heating means,

wherein said temperature-detecting means includes:

a dummy workpiece radiation thermometer which detects a radiation temperature of a dummy workpiece arranged in said heat treatment furnace;

a dummy workpiece contact thermometer which detects a contact temperature of said dummy workpiece;

a workpiece radiation thermometer which detects a radiation temperature of said workpiece; and

a workpiece temperature-calculating means which calculates said temperature of said workpiece by calculating a temperature difference between said radiation temperature and said contact temperature of said dummy workpiece and correcting said radiation temperature of said workpiece with said temperature difference.

21. (Withdrawn) The nitriding treatment apparatus according to claim 20, wherein said heat treatment furnace includes:

a nitriding treatment chamber which accommodates said workpiece and which is surrounded by an electrode plate for generating said glow discharge in cooperation with said workpiece;

a heating chamber which involves said heating element arranged around an outer circumference of said electrode plate and which is surrounded by a partition wall; and

a cooling means which is arranged around an outer circumference of said partition wall and to which a cooling liquid for cooling said partition wall is supplied.

22. (Withdrawn) The nitriding treatment apparatus according to claim 20, wherein said heat treatment furnace is a lateral type heat treatment furnace.

23. (Withdrawn) The nitriding treatment apparatus according to claim 20, wherein said workpiece is a crank shaft.